



**STANDARD FOR OPTICAL FIBER
OUTSIDE PLANT MICRODUCT CABLES**

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INSULATED CABLE ENGINEERS ASSOCIATION, Inc.

STANDARD FOR
OPTICAL FIBER
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Copies of this publication may be ordered online or by contacting:

IHS
15 Inverness Way East
Englewood, CO 80113-5776 USA
Telephone: (800) 854-7179
www.global.ihs.com

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FOREWORD

ICEA Standards are adopted in the public interest and are designed to eliminate misunderstanding between the manufacturer and user and to assist the user in selecting and obtaining proper products for his particular need. Existence of an ICEA Standard does not in any respect preclude the manufacture or use of products not conforming to the Standard.

The user of this Standard is cautioned to observe any applicable health or safety regulations and rules relative to the manufacture and use of cable made in conformity with this Standard. This Standard hereafter assumes that only properly trained personnel using suitable equipment will perform manufacture, testing, installation, and maintenance of cables defined by this Standard.

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The members of the ICEA Communications Cable Section, Working Group 744, who participated in this project, were:

Jim Register, Chairman and Editor

G. Dorna	R. Gould	N. Hatch
M. D. Kinard	J. Lichtenwalner	J. Mohler
D. Parke	M. Rainville	J. Ryan
T. Schmalzigaug	R. Stanko	R. Stevens
D. Taylor	T. West	H. Toland
P. VanVickle		

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PART 1

INTRODUCTION

1.1 Scope

1.1.1 Products

This Standard covers performance requirements for microduct optical fiber outside plant cables intended for installation in microducts, typically by blowing in using commercially available equipment intended for this application. Products covered by this Standard are intended only for operation under conditions normally found in outside plant communication systems. Typically, these products are installed in protected ducts but may be also run for short distances in both exposed areas and in concealed areas (such as handholes), with or without external protection. Due to the thinner jacket usually associated with microduct cables, they typically do not have the jacket durability to be pulled into conduit for long distances even at or below the rated tensile strength. Additionally, the impact resistance, compression resistance and tensile strength requirements for cables covered by this Standard may be significantly lower than those for conventional outside plant cables covered by ICEA-640. Therefore, installation of cables covered by this Standard by techniques such as capstan pulling, aerial lashing, trenching, and direct burial is not recommended.

1.1.2 Applications Space

Products covered by this Standard are intended for operation only under conditions normally found in communications systems. These products normally convey communications signals (voice, video, and data) including but not limited to point-to-point or point-to-multipoint installations. Products covered by this Standard may be factory terminated with connectors or splicing modules.

1.1.3 Temperature Ranges

The normal temperature ranges for cables covered by this Standard are given in Table 1.1.

Two temperature performance levels are specified for this Standard.

- Standard temperature performance - This level is considered to be in line with normal outside plant performance levels. This category will ensure performance in scenarios that include transitions between unconnected microduct systems or between a microduct system and some other protective structure, such as a conduit or tray.

- Moderate temperature performance – This level is characterized for installation in moderate climates or when the cable will not be exposed to short transitions below -30 °C (-22 °F).

If “Moderate Temperature Performance” is specified, the performance level should be clearly stated. This may be done using product specification sheets, customer quotations, or similar means.

Table 1.1 - Cable normal temperature ranges

Standard Temperature Performance	°C	(°F)
Operation	-40 to +70	(-40 to +158)
Storage and Shipping	-40 to +70	(-40 to +158)
Installation	-30 to +60	(-22 to +140)

Moderate Temperature Performance	°C	(°F)
Operation	-30 to +60	(-22 to +140)
Storage and Shipping	-30 to +60	(-22 to +140)
Installation	-10 to +50	(+14 to +122)

1.1.4 Tensile Rating

The minimum tensile rating for cables covered by this Standard is based on cable weight and is equivalent to the force exerted by the weight of 1,000 m of cable. While microduct cable should be blown into duct instead of pulled, a tensile strength is specified to provide durability and handling robustness.

1.1.5 Minimum Bend Diameter

The standard minimum bend diameters for cables covered by this Standard are:

Residual Condition (Installed): 20X Cable OD, or 30X for ribbon cables (≥ 216 fibers)

Loaded Condition (During Installation): 40X Cable OD

For very small cables, such as those installed in miniature ducts, manufacturers may specify a fixed cable minimum bend diameter (e.g., 300 mm) that is independent of the cable outer diameter (OD).

1.2 General

This Standard is so arranged that cables may be selected from numerous constructions covering a broad range of installation and service conditions. Parts 2 to 5 cover the major components and assembly of the cables:

Parts 2, 3, and 4 covers assembly, cabling, and identification of the individual optical fibers and conductors.

Part 5 describes coverings, such as binders, wraps, metallic coverings, and jacketing of the optical cable.

Part 6 provides other pertinent requirements not otherwise addressed by Parts 1 through 5 or by Part 7 of this Standard.

Part 7 contains the test methods and requirements applicable to completed cables and component parts. If there is a conflict between Parts 1 through 6 and Part 7, the provisions of Part 7 apply.

Part 8 contains routinely specified optical performance, requirements, and test methods for finished cables.

Part 9 contains cross-references to other standards and publications.

Annex A (Informative) contains information for users on ordering the types of cable products covered by this Standard.

Annex C (Informative) contains information on other ICEA Standards.

1.3 Units

In this Standard, metric (SI) units are used. Their approximate U.S. customary units are included where appropriate. Where approximate equivalents in alternate systems are included, they are provided for information only and in most cases are rounded off for measurement convenience. Unless otherwise specified, the Rounding Method of ASTM E 29 shall be used. ICEA P-57-653 is a useful guide for metric units used in this publication.

1.4 Definitions

For the purposes of this Standard, the following definitions apply.

1.4.1 Cable Classifications

1.4.1.1 Composite Cables¹

Cables containing more than one type of optical fiber.

1.4.1.2 Dielectric Cables

Cables containing no metallic members or other electrically conductive materials.

1.4.1.3 Hybrid Cables¹

Cables having both optical fibers and metallic conductors that are intended for communications use or powering.

1.4.1.4 Metallic Cables

Cables containing conductive members including those not normally intended to transmit information (voice, video, or data), such as metallic strength members, sheaths, shields, or armors.

This also includes elements intended for toning/locating.

1.4.2 Jackets and Sheaths

In this Standard, the term "jacket" refers to a continuous non-metallic covering while "sheath" refers to the protective elements covering the cable core, which may include a combination of metallic coverings, jackets, strength members, and the like.

1.4.3 Optical Fiber and Electric/Electronic Terms

Refer to TIA-440 and IEEE-812 for definitions of other optical fiber terms. Refer to ANSI/IEEE 100 for definitions of other electrical and electronic terms.

1.4.4 Detail Specification

The term "Detail Specification" shall be used to refer to any requirement or set of requirements that are specific to the user's purchase. In case of conflict between a requirement called out in a Detail Specification and this Standard, the requirements of this Standard may be modified by agreement between the manufacturer and user.

¹ ICEA Standards prior to 2012 use definitions for *composite* and *hybrid* which are the exact opposite of those shown here. The change in definitions was made in the interest of harmonization with international documents and other national standards. It must be noted that the definition of *composite* in the National Electrical Code, 2011 and earlier, are consistent with the older ICEA definition. Due to this change, users may see the terms used interchangeably. Regarding the definition for *hybrid*, as altered above: IEC uses a definition which encompasses metallic conductors used for all purposes – not just communication.

This definition does not apply to the optical fiber Detail Specifications referenced in Table 2.1 and Table 2.2 of this Standard.

1.5 References

All documents referenced herein are listed in Part 9.

1.6 Information to be Supplied by the User

When requesting proposals from cable manufacturers, the prospective user should describe the cable by referencing the pertinent paragraphs of this Standard. To help avoid misunderstandings and possible misapplication of cable, the user should also provide pertinent information concerning the intended application. Recommended ordering information is summarized in Annex A.

1.7 Modification of this Standard

Any part of this Standard may be modified by agreement between the manufacturer and user, but such modifications shall be clearly denoted as exceptions to the Standard. In this Standard, requirements which are recognized to have various options, but for which preferred values are given, have been introduced by phrases such as "unless otherwise specified," "as mutually agreed upon," or "unless otherwise modified by manufacturer and user." Requirements which must be determined in each case are introduced by phrases such as "...as agreed upon between manufacturer and user" or "...as mutually agreed upon."

1.8 Quality Assurance

It is the responsibility of the manufacturer to establish a quality assurance system consistent with TL 9000®, or an alternative system acceptable to the user. This will assure conformance with the requirements of this Standard. When the user wishes to require a specific quality assurance program or special testing procedures, agreement between the user and the manufacturer should be reached before the order is placed.

1.9 Safety Considerations

Materials in the cable shall present no dermal or environmental hazards as defined by current industry standards or applicable federal, state, or local laws and regulations.

The manufacturer and user of cables made in accordance with this Standard are cautioned to observe any applicable health or safety rules and regulations relative to their manufacture and use. This Standard hereafter assumes that manufacture, testing, installation and maintenance of cables defined herein will be performed only by properly trained personnel using suitable equipment and employing appropriate safety precautions. Cable materials shall comply with the requirements of the European Union Restriction on Hazardous Substances

(RoHS) directive, EU Directive 2002/95/EC for electrical and electronic components.

Cable materials shall not contain more than the maximum concentrations as prescribed by the latest RoHS Directive (see Note, below) of the substances listed below:

- Cadmium
- Hexavalent Chromium
- Lead
- Mercury
- Polybrominated Biphenyls
- Polybrominated Diphenyl Ethers.

Note: Use of certain potentially hazardous substances above allowed limits in electrical and electronic materials was banned in the European Union by the Restriction on Hazardous Substances (RoHS) Directive (EU Directive 2002/95/EC) as amended by the Commission Decision of 18 August 2005 (2005/618/EC). Although use of these substances has not been banned throughout the United States at the time this document has been issued, many other nations and jurisdictions, including the People's Republic of China and the state of California, have adopted similar legislation banning use of these substances above allowed limits in electrical and electronic materials.

The European Union has issued an updated RoHS Directive 2011/65/EU, commonly referred to as "RoHS 2", which went into effect on 2 January 2013. This recast directive superseded the original RoHS directive, which was officially repealed 3 January 2013. RoHS 2 is applicable to all equipment that has at least one intended function dependent on electrical or electromagnetic fields.

The EU Frequently Asked Questions document on RoHS 2 explicitly notes that optical cables are exempt from RoHS 2 (refer to section Q7.2 of http://ec.europa.eu/environment/waste/rohs_eee/pdf/faq.pdf). Although the restrictions of RoHS 2 are not applicable to optical cable, it is best practice to avoid use of these potentially hazardous materials.

In addition, compliance may be required with Article 33 of the European REACH Directive 2006/1907/EC (Registration, Evaluation, Authorization and Restriction of Chemicals), which obligates manufacturers to notify customers in the EU of the presence of cable materials or components that are classified as substances of very high concern (SVHC). A list of current and candidate SVHC can be viewed on the European Chemical Agency (ECHA) website to help determine compliance with the REACH Directive (refer to http://echa.europa.eu/chem_data_en.asp).

PART 2

OPTICAL FIBERS

2.1 General

The optical fiber used in the cable shall comply with the requirements set forth in the standards listed in Table 2.1 for multimode and Table 2.2 for single-mode glass core, glass cladding optical fibers.

2.2 Optical Fiber Classes

Optical fibers used shall be one of those listed in Tables 2.1 for multimode and Table 2.2 for single-mode fibers. Other types of fibers may be used as agreed between manufacturer and customer. Such fibers may include fibers of new design offering performance optimized for particular applications.

2.3 Optical Fiber Requirements

- 2.3.1 Unless otherwise specified, optical fibers shall conform to the requirements of the IEC 60793-2-10 and IEC 60793-2-50 specifications listed in Table 2.1 and Table 2.2.

Note: Fibers are commonly specified by reference to the IEC fiber specifications. Fibers are commonly designated using the terminology of the parallel ISO/IEC 11801 specifications for cabled multimode fiber and ITU-T G.650 series Recommendations for cabled single-mode fiber. TIA-4920000 series are commonly specified in North America. These mirror the IEC fiber specifications.

- 2.3.2 Each optical fiber shall be continuous throughout its length such that the requirements of Parts 7 and 8 of this Standard are met.

- 2.3.3 No spliced fibers are allowed.

2.4 Optical Fiber Coating and Requirements

- 2.4.1 Optical fiber (glass core and glass cladding) shall be coated with a suitable material to preserve the intrinsic strength of the glass. Such coated fibers are termed "Primary Coated Fibers."

- 2.4.2 The thickness of the primary coating(s) shall be such that the applicable requirements of this Standard are met. The coating diameter for standard 250 micron fiber is 235 to 265 μm , and for 200 micron fiber is 190 to 215 μm . Other coating diameters are acceptable as agreed between manufacturer and user, provided all other applicable requirements of this Standard are met. Dimensions shall be measured according to the methods of 7.9.

- 2.4.3 The diameter over the coating is defined as the diameter of the fiber as used in the cable; that is, the diameter includes any coloring thickness if the fiber is colored, and is the uncolored coating diameter if the fiber is not colored.
- 2.4.4 Coating materials used shall meet the requirements of Parts 7 and 8 of this Standard or as otherwise permitted by the user.
- 2.4.5 The coating(s) shall be uniform and concentric with the glass. Coating(s) shall be removable by mechanical means without damage to the fiber(s) by using manufacturer's recommended procedures. The strip force of the optical fiber's protective coating shall be measured according to FOTP-178. The force required to remove 30 ± 3 mm of the fiber's protective coating shall be between 1.0 N and 8.9 N. This requirement does not apply to removal of the material applied to tight buffered or semi-tight buffered (loosely bound buffer) fiber.

**Table 2.1 - Multimode fiber specification
(with informational cross reference)**

Fiber Type	ISO/IEC 11801 ^a	IEC Fiber Specification	TIA Detail Specification
62.5/125 μ m MM Fiber	OM1	60793-2-10, A1b	492AAAA-B
50/125 μ m MM Fiber ^b	OM2	60793-2-10, A1a.1	492AAAB-A
50/125 μ m Laser Optimized MM Fiber ^b	OM3 ^c	60793-2-10, A1a.2	492AAAC-B
50/125 μ m Laser Optimized MM Fiber ^b	OM4 ^c	60793-2-10, A1a.3	492AAAD
Notes: a) ISO/IEC 11801 is analogous to TIA-568 series (Commercial Building Wiring Standards). b) 60793-2-10, edition 5 defines the A1a fiber bandwidth grades, A1a.1, A1a.2, and A1a.3, with two levels of macrobend loss performance. The "a" suffix, e.g., A1a.1a, etc., will denote traditional macrobend loss performance levels, and those with the "b" suffix, e.g., A1a.1b, etc., will define enhanced macrobend loss levels. Therefore the "b" fibers will define bend insensitive multimode fibers. c) 50 μ m Laser Optimized MM fiber (OM3) is designed for 850 nm laser based operations but supports legacy LED data rates at 850 nm and 1300 nm. Mixing OM2 fibers in OM3 or OM4 links can disproportionately degrade performance and should be generally avoided.			